Requirements for the Next Generation Access Grid

Futures Laboratory

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The Access Grid

- Group to Group Collaboration

- Make computing, data, and knowledge resources widely available

- Spaces Designed to enable a shared sense of presence.

- Provide enough "Sense Data" from each site to make the interactions compelling enough to make users want to work in the shared spaces, not in their offices.

- Provide intuitive means to navigate the virtual space, find resources and people, work together to accomplish a common goal.

What We've Done

- LabSpace – ANL/NEU – MOO based scientific collaboration
  - tkSchmooze 1994 – Audio / Video Tools launched from MOO
  - Metro – Navigation, Resource Discovery, Resource Brokering
- Waterfall Glen 1994 – MCS Division MUD
- Collaborative VR –
  - CAVE to CAVE, CAVE to Desktop
  - ManyWorlds – Shared VR, MOO Based Spatial Database, Persistent Objects
- DOE2000 – ANL, LBL, PNNL, ORNL
- Tiled Displays – More pixels for bigger displays

Early Goals

- Leverage the spatial metaphor, it's a strong psycho-perceptual tool.

- Remote Groups Should be able to effectively work together

- Scenarios we thought should work include:
  - Site Visits/Demos – Subset ⇔ Many
  - Lectures – One ⇔ Many
  - Caucus – Subsets ⇔ Subsets
  - Discussions – All ⇔ All

  * Critical Criteria : A Subset is <u>not</u> a set of co-located people.

Where we are today

- Approximately 50 installed nodes
- Events happen daily
- Large Demos/Site Visits are routine
- Distributed research groups have progress meetings
- Project PI's have status meetings
- Tutorials occur approximately quarterly, but are getting more common
- Large distributed collaborations are underway
- Types of Interactions that work
  - Ad-Hoc meetings
  - Lectures
  - Panels
  - Question and Answer
- Wide Area Multicast is progressing

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Today's Architectural details

Record and Playback
Media Streams

Voyager Service

Value Added Services

Venue Server **Venue Server** **Venue Server**

Venues Services

Security
Spatial Scoping/Navigation
Resource Discovery
Venues Persistance

AG Node Client **AG Node Client** **AG Node Client** **AG Node Client**

Node Clients

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Today's Minimum Node Requirements

- 4 – NTSC Video Streams, transmitting at least 25 FPS.
- Decode and Display 40 – 256Kbps Video Streams
- 1 – 16KHz / 16 Bit Audio Stream
- 1 – Connection to the Venues MUD
- 1 – 3x XGA Projection Screen
- 1 – Control Workstation
- 100Mb local network connection
- at least 20Mb wide area connection
- Native Multicast working

Laundry List of Lessons Learned

- Hyperspace is not space: It's hard to leverage the innate knowledge of space
  - The world is not a desktop
  - People don't understand the technology unless they see it
- Changing workflow is not a technical problem
  - Agenda's keep meetings moving
- Technology needs to support human interactions, not interfere
  - E.g. Oprah Mics work, but are less than ideal for real interaction
    - Interaction Latency
    - Modality switching
  - Native Multicast is hard to make work both politically and technically
    - More technical advances are needed, standards, interoperability, and vendor support
    - More demand needed to influence service providers
    - More motivation for institutions to support it

A Glimpse of the Future

This is a hybrid peer to peer and client server model.

- Application Servers
  - Provide High Level Value Added Services
  - ANL's Voyager is an example
- Venues Servers
  - Distributed
  - Peer to Peer Service
  - Spatial Scoping of Resources
  - Provide Applications Services
- Networking Services
  - Stream Processing
  - Stream Transcoding
  - Stream Multiplexing
  - Stream QoS
- Node Clients
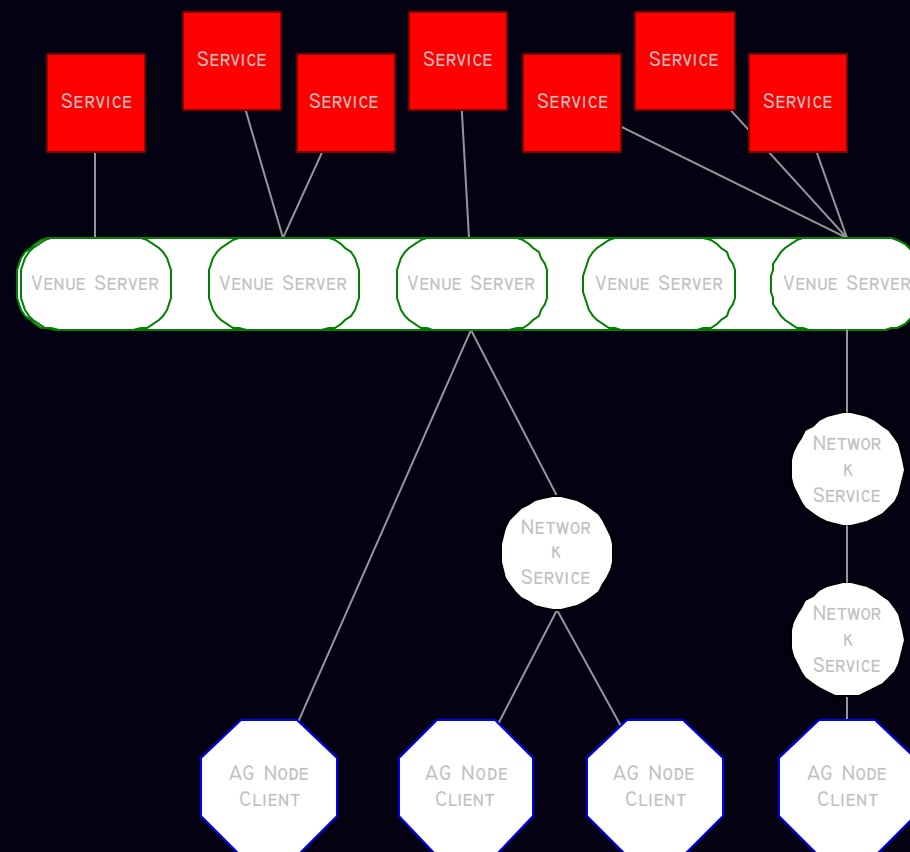
Requirements

- Increase the perception of presence.
  - Lower Latency
  - Higher Bandwidth
    - Capture and Rendering
  - More Environmental Transfer
    - Better Audio
      - Spatialized, Multiple Sources
    - Better Video
      - Higher Resolution, Better Codecs, Better Color Control, Better Lighting
  - 3D Expansion for Audio and Video
- Make it Easier to Use
  - Better User Interfaces
  - Better Control Structures
  - Scheduling needs to be addressed
    - Co-scheduling people, nodes, computing resources, etc
    - Perhaps including agenda management
- Device Integration Roadmap
  - Specialized Devices
  - Grid Resources for Computing and Data

More Requirements

- ## Application Server Infrastructure
  - Shared Communication Channels for Data, Control and View
  - Application Finding (MDS, UDDI, SLP, Salutation)

- ## Networking Service Infrastructure
  - Collaboration Based Dynamic Topologies
  - Network Resource Reservation / Negotiating QoS

- ## General Needs
  - Application and Data Caching?
  - Comprehensive Security Model
    - Integrates with local security domains
    - Global Sign-on
    - Provides ease of use, should not be a barrier to utilization

Node Technology

- Smaller/Portable Nodes – Scientific Labs, Wilderness Expedition, Homes
- Lecture Nodes – Webcasting
- Team Nodes – small groups of people operating the nodes simultaneously, like a Control Room.
- Node Improvements
  - Local Administrative Domain ← → Access Grid Distributed Integration
  - Dockable Workspaces – Users can interact with the node from laptops, handhelds, pdas, etc
  - More Asynchrony – Digest Type Interactions

Broader Use Scenarios

- ### Scientific Experiments
  - Data Security, Access Controls, Device Interfaces, Higher Bandwidths, Global Scheduling, Library/Literature interactions, Shared analysis tools, semi-synchronous

- ### Explorations in Nature
  - Low Bandwidth, "Digest Interactions", very asynchronous interactions with others, Remote Analysis, Expedition Planning & Changes

- ### Classrooms & Learning
  - Satellite participants, Low latency interaction, Peer-to-Peer communication, Document Sharing, Application Broadcasting, Internationalization

- ### Remote Medical Use
  - Extremely Low Latency, High Bandwidth, "Digest Notebooks", Device Integration, Remote Experts (find, contact, show data, ask opinion)

Technical Research Problems

- New Codecs emerging, integration takes time
- Better Processing, it's hard to stay ahead of the tech semi
- Networks Lagging Behind…For Now, we need more bandwidth (20Mbs now, 80Mbs if we had it)
- Digital Video Capture is lagging, Tiled Cameras? For higher resolutions?
- Digital Projection is lagging, Tiled Displays are still the only way to get very large displays.
- Stereo Acoustic Echo Cancellation
- Sound Virtualization incorporating echo cancellation